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CHINCH BUG CONTROL TESTS, 1956-57 [1]

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Previous tests established that very few of the insecticides commonly available in 1952-55 were consistently effective in control of the Florida lawn chinch bug, *Blissus insularis* Barber (Kerr, 1956a, 1956b; Wolfenbarger, 1953). In 1956 another series of tests was begun to screen additional chemicals, and those which looked promising for chinch bug control were selected for further testing in 1957.

1956 Tests. Methods and Materials

In 1956 tests were conducted in Orlando and Daytona Beach. The field-plot technique was similar to that used previously (Kerr, 1956a, 1956b). Plot size was 0.001 acre. The number of chinch bugs in one square foot of the most heavily infested part of each plot was ascertained by a flotation method. After the pre-application count was made, the numbers were arranged *á seriatum* and divided into two blocks of high population versus low population. Each treatment appeared once in each block. The pesticides and dosages used are shown in Table 1. Parathion was included as a standard by which to judge the performance of the other materials. Pesticides were applied in water with a sprinkling can at the rate of five gallons per 100 square feet. Subsequent counts were made at two-week intervals.

TABLE 1.—Pesticides Used in 1956 Chinch Bug Tests.

Pesticide	Formulation	Actual/acre
Parathion	46% Emul. Conc.	1.5 lbs.
Thimet	47.5 % Emul. Conc.	5 lbs.
Sevin	20% Emul. Conc.	5 lbs.
C & C 8305	26% Emul. Conc.	5 lbs.
Diazinon	25% Emul. Conc.	2, 4 lbs.
OS 2046	Water soluble liquid	2.6 lbs.
V-C 13	75% Emul. Conc.	112 lbs.
Chlorthion	44% Emul. Conc.	4 lbs.
Dylox	50% Water soluble powder	5 lbs.
Guthion	25% Emul. Conc.	10 lbs.

Results and Discussion

Tables 2 and 3 show the results attained. Several of the chemicals showed little promise and were dropped from further testing. These included OS 2046, chlorthion, Sevin, and Guthion. Guthion gave good initial control but was much less effective at later counts.

As expected, parathion gave very satisfactory control. The nematicide V-C 13 gave the best control, but it was used at the very heavy nematicidal

[1] Florida Agricultural Experiment Station Journal Series, No. 724.

TABLE 2.—Results of Chinch Bug Control Tests—1956. Average of All Plots at Both Locations. Figures in the Table are Numbers of Chinch Bugs per Square Foot.

	Check	2046	Clth.	Sevin	Guth.	Diaz.	8305	Thimet	Par.	V-C 13	Dylox
Pre-Count	48.5	23.5*	16.5*	22.5*	36.5*	80.5	40.5	34.0	33.0	48.0	41.0*
2 weeks	53.8	16.5*	199.0*	10.0*	5.0*	4.8	1.0	0.8	2.25	0.0	1.5*
4 weeks	59.0	——	——	17.0*	32.0*	24.0	5.5	7.0	3.25	0.0	9.0*
6 weeks	83.5*	——	——	55.5*	129.5*	21.0*	2.0*	0.5*	0.5*	0.0*	——

* = data from only 2 replicates and at one location, rather than 4 replicates.

dosage, and further tests at more economical amounts were required of this material. Thimet, Diazinon, Dylox, and C&C 8305 gave promising results, too.

TABLE 3.—Multiple Range Analysis of the Inseticides Which Were Used in Two Replicates at Each of Two Locations in 1956. Figures in the Table are Numbers of Chinch Bugs per Square Foot.

	Check	Diazinon	Thimet	Parathion	8305	V-C 13
Pre-Count	48.5	80.5	34.0	33.3	40.5	48.0
2 weeks	53.8	4.8**	0.8	2.3	1.3	0.3
4 weeks	59.3	24.0	7.0	3.3	5.5	0.0
6 weeks*	83.5	21.0	0.5	0.5	2.0	0.0

* Data from Orlando only; not statistically analyzed but included for comparison.

** Any two means underscored by a given line are not significantly different from each other at the 5% level. Any two means not underscored by the same line are significantly different.

1957 Tests. Methods and Materials

In 1957 the five promising pesticides found in the previous year were given further trials. During 1956 and early 1957 reports were received from commercial spray operators that DDT was no longer controlling chinch bugs in some areas. As a check on these reports, DDT was included in the tests at three different locations. Several other insecticides which had not been previously tested by the writers were tried on a smaller scale.

Tests were conducted in Sarasota, Boca Raton, Lauderdale by the Sea, and Jacksonville. Plot size in Lauderdale by the Sea was 0.001 acre, but at the other locations was 0.0015 acres. Table 4 shows the materials and dosages used. The technique used was the same as in 1956, except that four of the materials were tried in one versus two applications and three replications were used. Thimet, Dylox, and DDT were the materials first tried in one versus two applications. Thimet was omitted from the test in Jacksonville, because its effectiveness had been demonstrated and because its unavailability and very strong odor would seem to preclude its practical use

TABLE 4.—Chinch Bug Test Insecticides—1957.

Material	Formulation	Actual Per Acre in Lbs.
DDT	25% Emul. Conc.	10
Dylox	50% Soluble Powder	5
Diazinon	25% Emul. Conc.	4
Thimet	47.5% Emul. Conc.	5
8305	46% Emul. Conc.	10
V-C 13	75% Emul. Conc.	16
Thiodan	2#/gal. Emul. Conc.	5
Toxaphene	6#/gal. Emul. Conc.	10
Endrin	20% Emul. Conc.	2
Aldrin	2#/gal. Emul. Conc.	5

TABLE 5.—CHINCH BUG CONTROL RESULTS—1957. AVERAGE NUMBER OF CHINCH BUGS PER SQUARE FOOT.

Treatment	Pre-Treatment Count	2 Weeks	4 Weeks	6 Weeks	8 Weeks
Sarasota (Test area No. 1)					
Check	85	82	67	96	157
DDT	63	55	59	—	—
DDT*	71	59	82	—	—
Dylox	78	0	7	16	39
Dylox*	92	1	1	4	8
Thimet	75	1	0	0	4
Thimet*	74	1	0	1	5
Sarasota (Test area No. 2)					
Check	44	66	43	58	—
Diazinon	52	0	1	9	—
8305	49	1	2	5	—
V-C 13	40	5	2	3	—
Toxaphene**	34	30	—	—	—
Thiodan**	31	38	—	—	—
Check	66	43	58	—	—
Aldrin**	32	32	—	—	—
Endrin**	36	11	37	—	—
Boca Raton					
Check**	66	47	38	53	—
DDT**	109	11	11	19	—
DDT*, **	44	7	8	10	—
Diazinon	71	3	2	12	—
8305	63	4	5	3	—
Jacksonville					
Check	42	55	34	—	—
DDT	51	0	0	—	—
DDT*	49	0	0	—	—
Dylox	57	12	3	—	—
Dylox*	48	12	0	—	—
Diazinon	46	0	1	—	—
Diazinon*	46	0	0	—	—
V-C 13	38	0	0	—	—
Lauderdale by the Sea					
Check**	54	44	—	—	—
Toxaphene**	60	28	—	—	—
Aldrin**	75	41	—	—	—
Endrin**	70	23	—	—	—
Check*	44	41	—	—	—
Thiodan*	41	26	—	—	—

* Two applications; 14-day interval.
** Average of only two replicates; rest are average of three.

in the near future. Diazinon was used in place of Thimet. Thiodan, toxaphene, aldrin, and endrin were applied only in two replicates at the locations where they were tried.

Results and Discussion

Table 5 shows data for the materials tested in 1957. The outstanding feature of the test in Sarasota was the failure of DDT to control chinch bugs, whether one or two applications were made. In a test conducted in the same neighborhood four years previously, two applications of the same DDT dosage gave excellent control (Kerr, 1956a). Commercial spray operators in that area have reported increasing difficulty in obtaining control with DDT.

One application of Thimet was as effective as two, but Dylox requird two applications to give good long-term control. Diazinon gave satisfactory control. The V-C 13, which was used at a greatly reduced amount from the previous year's nematicidal dosage, left several chinch bugs per square foot. However, the residual effectiveness of a single application gave an over-all control that compared favorably with the best of the other materials. Union Carbide Chemicals Company's 8305 gave excellent control. Thiodan, toxaphene, aldrin, and endrin gave unsatisfactory control in Sarasota and in the southern part of the state and are not being considered further.

For the first time in a long series of chinch bug tests, some unknown factor was encountered in the Boca Raton test which decimated the chinch bug population in a large part of the lawn. Only fragmentary information could be collected from this work, and Table 5 shows data from a few plots in part of the lawn where the chinch bugs remained alive in the check area. DDT gave moderately good control. Where only one DDT application was used, however, after six weeks the population had built up to a level that was close to being damaging in size. Again, Diazinon and 8305 gave satisfactory control.

In Jacksonville, DDT, Diazinon, and V-C 13 gave excellent control with one application. A single application of Dylox did not compare well.

As a result of the tests during the past two years, Diazinon and V-C 13 have been added to DDT and parathion as satisfactory materials for chinch bug control. It is true that certain additional pesticides have given effective control, but at this time they are not available. The newly recommended materials and dosages are: 25 percent Diazinon emulsion concentrate at the rate of 1 to 2 pints per 5,000 square feet of lawn; V-C 13 at the rate of 1 to 2 quarts per 5,000 square feet. Two applications of Diazinon, at an interval of 1½ to 2 weeks, are required for thorough control, but one application of V-C 13 is sufficient. The lower dosages have given satisfactory control in several tests, but the higher dosages are suggested for the southernmost parts of the state where conditions of turf development and climate are more extreme.

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TESTS WITH POISON BAITS AGAINST COCKROACHES

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Poison baits consisting of some food material with a toxicant such as phosphorus or boric acid have been used for many years for controlling the cockroaches (Mallis 1954, pp. 181-5). Recently Keller *et al.* (1956) reported that a bait consisting of cornmeal (73 percent), Coca-Cola sirup (25 percent), and Dipterex (2 percent) controlled *Periplaneta* spp. in homes for 30-60 days. This paper presents an evaluation of various poison-bait formulations against the American cockroach (*Periplaneta americana* [L.]) or mixed populations of this species with *P. brunnea* Burm. and the Australian cockroach (*P. australasiae* [F.]) and against the German cockroach (*Blattella germanica* [L.]).

Laboratory Tests

A large number of food materials were tested, separately and in combination, as 2-percent Dipterex poison baits. An acetone solution of insecticide was mixed with the food material. After the acetone evaporated, the bait was placed in small plastic vial lids. Small wads of cotton were soaked in the liquid baits to facilitate feeding by the cockroaches. The baits were exposed to the cockroaches in cylindrical screen cages or plastic refrigerator dishes. The cockroaches were also supplied with dog food and water. An excess of bait was used to permit *ad libitum* feeding. Two to six tests were run with each bait, with five American cockroach nymphs or five or ten German cockroach adults per test. Knockdown and mortality counts were taken after various periods of exposure. Results of tests with baits that killed at least 90 percent after 48 hours are recorded in Table 1.

Against American cockroaches, dextrin, cornstarch, and powdered sugar, alone or in combination with each other or different food materials, were the most effective dry baits, and Coca-Cola, root beer, and vanilla sirups were the most effective liquid baits. Powdered sugar was the most effective bait against German cockroaches. With this exception, German cockroaches accepted liquid baits more readily than dry baits whereas American cockroaches showed little preference.

Tests in Rooms, Homes, and Dairy Barns

A number of bait tests were run with selected food materials in rooms, homes, or dairy barns. The baits were prepared in the same manner as for the laboratory tests but not always with the same insecticide or concentration. Cornmeal was used in most formulations to add bulk, absorb moisture, and make the baits easier to apply.

Coca-Cola sirup and a mixture of cornmeal and powdered sugar containing 1 percent of Dipterex were tested against infestations of German cockroaches in rooms. The rooms were sealed so that no roaches could escape. Approximately 67 grams of bait was divided among three stations in each room. This was sufficient to provide *ad libitum* feeding. In another

TABLE 1.—Attractiveness to Cockroaches of Various Food Materials in Baits Containing 2% of Dipterex. Laboratory Tests.

Food Material (figures indicate percent)	Percent knockdown and kill after— 1 hour	2 hours	4 hours	24 hours	48 hours
American cockroaches					
Dextrin 50, cornmeal 50	0	0	70	100	100
Dextrin 50, cornstarch 50	0	0	60	100	100
Pepsi-Cola sirup	0	0	40	100	100
Powdered sugar 25, cornmeal 75	0	13	27	100	100
Vanilla sirup	0	10	20	100	100
Root beer sirup	0	0	10	100	100
Fructose water solution	0	0	0	100	100
Coca-Cola sirup	0	0	25	95	100
Dextrin 45, dried ox blood 10, cornmeal 45	0	0	15	85	100
Peanut oil	0	0	0	95	95
Cornstarch	0	0	15	90	95
Dextrin	0	0	27	93	93
Dextrin 50, peanut oil 50	0	0	30	90	90
Brewers' yeast (dried)	0	0	10	90	90
Dried ox blood	0	0	0	90	90
Dextrin 33⅓, dried brewers' yeast 33⅓, cornstarch 33⅓	0	0	0	90	90
Maltose water solution	0	0	0	90	90
Cherry sirup	0	0	10	80	90
Cornmeal 33⅓, dextrin 33⅓, dried brewers' yeast 33⅓	0	0	10	80	90
German cockroaches					
Powdered sugar	0	5	80	100	100
Cornmeal 75, powdered sugar 25	0	23	56	100	100
Root beer sirup	0	0	60	100	100
Vanilla sirup	0	0	20	100	100
Orlando fly food*	0	5	15	100	100
Strawberry sirup	0	0	10	100	100
Sucrose water solution	0	10	10	90	100
Maltose water solution	0	0	0	80	100
Coca-Cola sirup	0	0	10	90	95
Cherry sirup	20	20	40	80	90
Dextrin 25, dried ox blood 10, cornmeal 25, Coca-Cola sirup 40	0	0	20	80	90

* 25% raw egg, 6% powdered milk, 34.5% honey, and 34.5% malt extract.

TABLE 2.—Results of Tests with Poison Baits Containing 1% Dipterex Against German Cockroaches Confined in Rooms.

Bait (figures indicate percent)	Amount dispensed (grams)	Pretreatment count	Percentage reduction after— 1 day	2 days	3 days	4 days	8 days	11 days
Stations								
Coca-Cola sirup	67	7,079	7	—	—	16	22	27
		10,367	7	—	—	14	19	23
		809	19	—	—	29	33	48
Cornmeal 74, powdered sugar 25	67	2,670	3	—	—	11	20	24
		867	12	—	—	23	28	34
		989	4	—	—	7	8	12
Dusts								
Cornmeal 74, powdered sugar 25	125	2,024	37	42	46*	56	68	74
	150	5,174	50	53	56*	69	82	87
		7,978	47	51	55*	66	79	84
	75	872	33	36	40	47	57	63

* After this count the room was dusted again.

TABLE 3.—Tests with Baits Containing 1% Dipterex Against Cockroach Infestations in Homes.

Bait (figures indicate percent)	Amount dispensed (grams)	Number of dead cockroaches/number of live cockroaches after— 1 day	2 days	5-6 days	8-10 days	12-13 days	15-16 days	19-20 days	22-23 days	26-27 days
Stations				*Periplaneta* spp.						
Cornmeal 74, Coca-Cola sirup 25	225	10/1	2/0	4/0	0/0	0/0	*	—	—	—
		10/1	1/0	0/0	1/0	0/0	*	—	—	—
		—	25/0	3/0	—	—	*	—	—	—
Granulated sugar	225	4/6	5/3	0/3	5/0	6/0	2/0	1/1	0/0	0/2**
		2/0	1/0	1/0	0/0	0/0	*	—	—	—
		70/1	27/0	9/3	3/2	1/1	—	16/0	15/0	3/0†
		40/2	15/0	14/1	3/1	6/4	—	0/0	0/0	1/0‡
		12/1	15/0	0/0	0/0	0/0	0/0	2/1	2/1	—§
Cornmeal 74, white Karo sirup 25	112	0/0	1/0	3/0	2/0	0/0	0/0	0/0	0/0	1/0
		0/0	2/0	1/0	1/0	0/0	0/0	0/0	0/0	0/0
		0/0	3/0	2/0	3/0	0/0	0/0	0/0	—	0/0
		0/0	2/0	—	0/0	0/0	0/0	0/0	0/0	0/0
Cornmeal 74, powdered sugar 25	112	1/0	—	1/1	0/0	3/0	0/0	0/0	0/0	1/0
		5/0	2/0	3/0	0/0	2/0	2/0	0/0	0/0	0/0
		3/0	1/0	0/0	0/0	0/0	0/0	0/0	1/0	1/0
Dust										
Cornmeal 74, powdered sugar 25	225	40/8	3/7	0/3	—	0/0	0/0	—	—	—
		12/7	7/0	0/0	—	0/0	0/0	—	—	—
		3/3	0/0	0/0	—	0/0	—	—	—	—

TABLE 3.—Tests with Baits Containing 1% Dipterex Against Cockroach Infestations in Homes.—Continued

Bait (figures indicate percent)	Amount dispensed (grams)	Number of dead cockroaches/number of live cockroaches after— 1 day	2 days	5-6 days	8-10 days	12-13 days	15-16 days	19-20 days	22-23 days	26-27 days
				German cockroaches						
Stations										
Cornmeal 74, white Karo sirup 25.....	112	10/90	6/80	12/78	3/38	3/52	0/50	0/49	0/50	0/80
		6/85	3/66	20/45	15/50	10/20	1/39	5/40	4/30	3/60
		4/50	10/50	17/50	17/47	5/17	2/33	3/73	——	2/55
		8/30	14/40	——	5/52	3/10	0/36	0/45	0/40	0/40
Powdered sugar	50	0/50	0/40	4/61	——	——	——	——	——	——
		——	0/60	4/47	——	——	——	——	——	——
		0/50	2/70	0/63	——	——	——	——	——	——
Cornmeal 74, powdered sugar 25	112	10/80	——	3/50	5/40	5/55	1/69	32/50	5/55	8/47
		5/93	9/93	12/50	13/29	4/20	4/42	15/30	3/40	5/34
		2/90	6/50	0/35	2/32	2/15	2/50	0/30	2/33	1/35
Dust										
Cornmeal 74, powdered sugar 25.....	225	33/120	10/115	0/117	——	0/120	0/130	——	——	——
		40/250	22/240	0/240	——	0/240	0/230	——	——	——
		12/210	0/200	0/200	——	0/175	——	——	——	——

* Test discontinued because bait was not giving satisfactory control of German cockroaches on these premises and it was necessary to apply a residual treatment.

** 0/0 after 37 days.
† 0/3 after 40 days.
‡ 0/2 after 40 days.
§ 0/0 after 54 days.

TABLE 4.—Tests Against *Periplaneta* spp. in Dairy Barns with Baits Containing 2% of Malathion or Dipterex.

Bait	Dairy	Dosage (grams)		Pretreatment count	Percent control after—				
					First treatment			Second treatment	
		First treatment	Second treatment		1 day	7 days	14 days	1 day	7 days
Dipterex plus—									
Cornmeal-Coca-Cola sirup	Arndt	834	900	57	88	29	—	91	93
	Brockbank	1,816	800	68	88	47	12	81	79
	Fennell	640	—	158	87*	—	82	—	—
Cornmeal-dextrin	Palm	900	—	316	87	95	75	—	—
	Mole	600	—	147	84	95	**	—	—
Malathion plus—									
Cornmeal-Coca-Cola sirup	Palm	900	900	209	60	63	—	—	34
	Fennell	600	—	168	6	—	—	—	—
Cornmeal-dextrin	Mole	600	500	153	73	63	—	—	4

* Bait washed out; retreated after 1 day with 600 grams of same bait.
** Dairy barn sprayed for flies.

test the cornmeal-powdered-sugar bait was applied as a dust from a small plastic catsup dispenser. In three of the rooms in this test it was necessary to replace bait that was eaten or became scattered and was swept out when mortality counts were taken.

Table 2 shows the cornmeal-sugar bait applied as a dust to be the most effective, but that at the stations the Coca-Cola bait was better.

Tests in homes were made with baits containing 1 percent of Dipterex in the following food materials: granulated sugar, powdered sugar, and mixtures of cornmeal plus white Karo sirup, powdered sugar, or Coca-Cola sirup. In one series the baits were put in small piles in out-of-the-way areas or exposed in nut cups or envelopes. The cups were set on flat surfaces and the envelopes stapled to vertical surfaces in or behind cupboards, behind sinks, refrigerators, and stoves and in other places where they would not be washed or swept away and were not readily accessible to children. In a second series of tests a mixture of finely ground cornmeal and powdered sugar plus the toxicant was applied as a dust with small plastic catsup dispensers. The treatments were evaluated by making regular inspections of the premises for dead and live roaches. The results given in Table 3 show that all the baits reduced the populations of *Periplaneta* but none were appreciably effective against the German cockroaches.

In 1955 and 1956 tests were run against large mixed populations of *Periplaneta* in several dairy barns. The baits contained 2 percent of Dipterex or malathion, 73 percent of cornmeal, and 25 percent of Coca-Cola sirup or dextrin. Small piles of the bait were placed in corners, cracks, and in other places where it would not be washed or swept away. When less than 75 percent control was obtained after one week, a second application was made.

In most of the dairies roach control was determined by taking flash pictures at night. After the barns were vacated in the evening, the cockroaches crawled from their hiding places looking for food, and a large proportion of them were located near or in the feed troughs and in the feed rooms. Control was based on the reduction in the number of cockroaches in three or four pictures before and after treatment. When low populations were present, it was possible to make an accurate visual count with the aid of a dim light. Percent control in the Fennell dairy was based on such visual counts. After two weeks most of the bait had been destroyed, and counts were discontinued. The results are presented in Table 4.

Both baits gave good control when Dipterex was used as the toxicant (75 to 95 percent after one or two treatments, based on the original pretreatment count). When malathion was used, control ranged from 4 to 34 percent.

Summary

Laboratory and field tests with various poison bait formulations against cockroaches are presented. In laboratory tests with 2-percent Dipterex baits, powdered sugar showed the greatest attractiveness to German cockroaches (*Blattella germanica* [L.]), and dextrin and cornstarch alone or in combinations were the most attractive to nymphs of American cockroaches (*Periplaneta americana* [L.]).

In rooms and homes none of the baits tested against German cockroaches gave satisfactory control. Baits consisting of 1 percent of Dipterex in gran-

ulated sugar or mixtures of cornmeal plus Coca-Cola sirup, powdered sugar, or white Karo sirup were effective in reducing infestations of *Periplaneta* spp. in homes. Seventy-five to 95 percent control of *Periplaneta* spp. in dairy barns was obtained with baits containing 2 percent of Dipterex in cornmeal plus dextrin or Coca-Cola sirup. When malathion was used as the toxicant, control ranged from 4 to 34 percent.

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From August 17 to August 25, 1960, there will take place in Vienna the ELEVENTH INTERNATIONAL CONGRESS OF ENTOMOLOGY. Interested persons, not yet having received a circular letter, are asked to contact the secretary's office of the Congress, Vienna I., Burgring 7, by postcard as soon as possible. Further information will be sent to them immediately.

LIMNETIC DISTRIBUTION OF *CHAOBORUS* LARVAE IN A DEEP FLORIDA LAKE (DIPTERA: CULICIDAE)

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Over a period of several years (1950-1957) visits were made to Deep Lake, Collier County, for the purpose of obtaining limnological data. On all occasions on which a vertical series of plankton collections were made it was noted that larvae of a species of the phantom midge, *Chaoborus*, were always present in the plankton obtained from the deeper waters and exhibited a rather definite vertical distribution related to the size of the larvae.

Because of the difficulties attendant to reaching and studying the lake, the sampling period was restricted to the hours between about 10:00 a.m. and 3:00 p.m. Water samples were obtained at various depths for chemical analysis and plankton studies by means of modified Kemmerer water samplers of 1189 and 2111 ml. capacity. The quantity of water obtained for a sample at a given depth varied from 10.6 to 40.5 liters and usually amounted to 20 to 30 liters. Plankton was concentrated by means of a net constructed of number 25 silk bolting cloth and preserved in approximately 8 per cent formalin. *Chaoborus* larvae were measured by means of a linear ocular micrometer and a dissecting microscope. Samples of the bottom material from depths between 70 and 95 feet were secured with an Ekman dredge. This material was washed in fine screens and examined for macroscopic organisms. Subsurface temperature measurements were obtained by employing a deep-sea reversing thermometer. Chemical analyses were conducted according to accepted procedures.

Lake Characteristics

Deep Lake has some unusual characteristics and a brief description of it seems appropriate. The lake is located in Collier County about one-hundred yards east of State Highway 29 and ten miles north of the Tamiami Trail, on the edge of the Big Cypress Swamp. It is nearly circular in outline with an open-water surface area of about 1.6 acres. During high water periods it extends into the surrounding swamp for a considerable distance. The maximum depth varies from about 95 to 98 feet, depending on the general water level in the area. The basin forms a rough cone with the apex slightly east of the lake center. There is a slightly shelving, narrow littoral zone which gives way to a rock-rimmed drop-off which is vertical for distances of 25 to 50 feet. The bottom of the deeper region slopes rapidly into the single depression. Parker and Cooke (1944) consider Deep Lake to be of sinkhole origin.

The lake is thermally stratified and exhibits distinct dichothermy. There is a marked decrease in temperature from the surface to a depth of about 30 feet. From that point the temperature is virtually uniform down to about 85 feet. In various years the temperature of this uniform zone has varied between 16.6° and 18.0° C. Beyond 85 feet there is a slight but marked increase in temperature. Correlated with the vertical temperature pattern are certain chemical conditions which indicate that the deeper

waters are in a permanent state of meromixis. The pH of the lake water usually ranges between 7.1 and 7.8. With the exception of one occasion, free carbon dioxide was present in surface waters and always increased to over 20 ppm. in deeper waters. Hydrogen sulfide was present below depths of about 20 feet and increased greatly below 85 feet. Dissolved salts also increased greatly in the deepest regions. No dissolved oxygen was ever found at or below 20 feet and amounts at 10 feet ranged from 0.3 to 4.1 ppm. The slightly brown water was clear on all occasions and turbidity measured less than 7 ppm.

The unusual nature of the water mass in Deep Lake is due primarily to the small surface area, extreme depth, and protection from wind action afforded by the high trees which surround the lake margin. The water mass and associated bottom would seem to provide a very unfavorable habitat for aerobic organisms at depths greater than about 18 feet.

Vertical Distribution

Chaoborus larvae are a usual constituent of the insect fauna of lakes in North America (Muttkowski, 1918; Eggleton, 1931; Johannsen, 1934; Deevey, 1941; Welch, 1952; and others). Published information shows that the larvae may be considered both as a benthic and planktonic form. At times they are extremely abundant in the bottom mud, numbers as high as 71,500 individuals per square meter having been reported (Eggleton, 1931). Their daytime abundance as a limnetic form may vary from a few score to a few thousand individuals per cubic meter of water.

The larvae are capable of moving actively, and in many localities definite diurnal vertical migratory movements have been observed (Juday, 1921, 1922; Eggleton, 1932; and others). In these cases the bulk of the population moves up into the surface waters at night and retreats to the deeper waters or into the bottom mud during the day. The frequently reported occurrence of larvae in plankton samples indicate that at least the smaller ones are commonly limnetic in the day time although they are not usually found in the surface waters during the middle of the day.

The vertical distribution of larvae in Deep Lake on nine different dates is shown in Table 1. Six collections were obtained in the spring between April 12 and May 2, two in winter and one in July. Larvae were always present in the water stratum between 30 and 60 feet and usually occurred in both shallower and deeper regions. The larval distribution was continuous from the upper limit at which they were encountered downward to the maximum depth occupied on a given date. On six occasions they were first encountered at the ten foot depth but only once were they found in the surface layer. On most dates larvae were collected at depths of 85 to 90 feet. None were ever found at a depth of 95 feet. On April 12, 1957, the vertical range of the population extended from the surface to 90 feet. The most restricted vertical range was encountered during a cold period on February 7, 1953, when larvae were present only between 30 and 60 feet.

The number of larvae varied greatly on the various sampling dates. Data are too limited to speculate on seasonal abundance, but it may be significant that the smallest population was found at the time of the winter samples and the largest number of larvae were present in July.

TABLE 1. Abundance and Vertical Distribution of *Chaoborus* Larvae in Deep Lake.
Number of Larvae per Cubic Meter

Depth in Feet	April 28, 1951	April 26, 1952	Dec. 30, 1952	Feb. 7, 1953	May 2, 1953	May 1, 1954	April 14, 1956	April 12, 1957	July 13, 1957
1.5	0	0	0	0	0	0	0	254	0
5	0	0	0	0	0	0	0	——	1042
10	210	0	0	0	510	388	132	2600	6345
15	——	——	——	——	1026	429	2547	——	1326
20	350	173	47	0	910	836	1335	1032	1042
25	——	——	——	——	957	——	——	——	1800
30	769	616	94	26	1479	776	1446	818	3125
40	874	——	284	189	2017	——	491	1006	2118
50	454	332	——	——	——	149	——	——	——
60	——	——	94	284	652	——	656	943	473
70	280	134	0	0	515	60	——	973	——
80	——	——	0	0	——	——	248	——	——
85	78	0	0	0	——	——	——	——	95
90	27	0	0	0	86	30	141	635	0
95	0	0	0	0	0	0	0	0	0

Pupae were encountered infrequently and those collected were obtained at depths between 25 and 60 feet.

One or two samples of the bottom material from 70 to 95 feet were obtained and examined on most visits to the lake. No macroscopic organisms were found. The material is a mixture of pulpy and fibrous peat, brown in color, oily, and extremely odorous. It seems likely that the larvae do not enter this material, at least in the deep areas, and are therefore primarily limnetic.

The apparent permanent lack of oxygen below about 18 feet means that the larvae live, for much of the time at least, in an anaerobic environment and can tolerate the extremely stagnant conditions in the region below 80 feet. *Chaoborus* larvae are well known for their ability to exist as anaerobes (Welch, 1952; and others); however, they cannot survive indefinitely under such conditions. Eggleton (1931) reports that they can tolerate a pH range from 3.0 to 9.2, excessive amounts of carbon dioxide, and oxygenless conditions for several days to several weeks. Larvae held in jars placed on a lake bottom in anaerobic conditions died within a few weeks (*loc. cit.*).

It is likely that diurnal migration occurs in Deep Lake and the larvae obtain relief from stagnant conditions during the night by moving to or near the surface.

Size Distribution

An increase in size of larvae with increase in depth was noted on almost every date on which samples were taken. The smallest, hence youngest, larvae occupied the upper strata and the larger individuals inhabited the deeper waters. This separation of the larval groups on a basis of size was nearly complete since few individuals of markedly different size were found at the various depth levels. Similar conditions have been found in other lakes. The usual size distribution associated with depth is shown for three dates in Table 2. Most of the small larvae were above the 30-foot depth and most of the larger specimens were found at greater depths. Almost all specimens collected at depths of 40 feet or greater were near maximum size for that date. Larvae found in the winter collections were all half grown, of nearly uniform length (7-8 mm.), and occupied the middle third of the water mass.

The size of adult larvae in Deep Lake is not known for certain, but probably ranges from about 9 to 12 mm., the length range of the largest specimens encountered on April 14, 1956. In Michigan, mature larvae range in length from about 10 to 12 mm. (Eggleton, 1932).

Length measurements were arranged into length-frequency polygrams for the various collection dates in order to determine the number of size- and age-groups present. Results were inconclusive since on some occasions only one mode was evident while on others a definite bimodal curve or the suggestion of one existed. Selected length-frequency data, typical of the conditions encountered, are shown in Table 3. It is probable that during the spring and summer two size- and age-groups are present as compared to the one obvious size-group present in the winter. In certain Michigan lakes three size-age groups were present during the winter months (Eggleton, 1932). Nothing is known concerning emergence of the adults at Deep Lake

TABLE 2. Lengths of Larvae Occurring at Various Depths on Three Selected Occasions. Lengths in Millimeters.

Depth in Feet	April 14, 1956			April 12, 1957			July 13, 1957		
	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.
1.5	0.0	0.0	0.0	1.3	4.8	3.1	0.0	0.0	0.0
5	0.0	0.0	0.0	—	—	—	1.6	4.8	3.2
10	1.7	2.8	2.3	1.7	5.7	3.6	1.3	8.1	3.7
15	2.1	7.1	4.0	—	—	—	1.7	5.9	4.3
20	2.2	8.5	4.9	1.6	5.7	4.3	4.7	5.5	5.0
25	—	—	—	—	—	—	4.7	6.8	5.7
30	4.7	10.4	8.1	4.9	7.1	5.8	6.4	8.6	7.2
40	4.8	11.3	8.9	5.4	8.5	6.5	6.7	9.6	7.6
60	3.6	12.4	9.7	6.2	8.7	7.5	6.2	8.2	7.2
70	—	—	—	7.0	8.2	7.6	—	—	—
80	4.7	12.3	9.4	—	—	—	—	—	—
85	—	—	—	—	—	—	6.7	6.8	6.7
90	10.8	12.5	11.6	7.1	8.5	7.7	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

and continuous sampling would be necessary to work out the life cycle of the insect.

TABLE 3. Length-Frequency Distribution of Larvae on Selected Dates in Deep Lake.

Length in mm.	1	2	3	4	5	6	7	8	9	10	11	12
Number of Individuals Dec. 30, 1952 and Feb. 7, 1953							21	13				
Number of Individuals April 14, 1956		4	16	15	20	9	4	8	10	16	13	3
Number of Individuals April 12, 1957		6	15	20	26	23	36	47	5			
Number of Individuals July 13, 1957	1	6	17	33	21	13	35	39	3	1		

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NOTES ON THE IDENTITY, HABITAT AND DISTRIBUTION OF SOME SEMI-AQUATIC HEMIPTERA OF FLORIDA

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In 1950 and 1951, Jon L. Herring published four papers in the Florida Entomologist on the aquatic and semi-aquatic Hemiptera of northern Florida. In these he omitted the Hebridae, Saldidae, Ochteridae, and Gelastocoridae, all of which are generally referred to as semi-aquatic Hemiptera, but actually are hygrophilous to littoral by nature.

This paper presents notes on my collections in these families from 1951 through 1954 and gives keys to genera and species. A few species that occur in Florida, but which I have not collected, are included.

Most of my collections were made in the vicinity of Orlando and between Orlando and the East Coast. No attempt was made to collect all species from different counties or localities. Unless studies were being conducted in certain groups, only a small series of specimens was taken, and the number of specimens collected does not necessarily reflect the abundance of the species.

Family Hebridae

(Velvet Water-bugs)

Key to the Genera of Hebridae

A Antenna of dried specimens apparently five-segmented, the extremely long fourth segment constricting at or near its middle so as to simulate a joint ..... *Hebrus* Curtis

A′ Antenna four-segmented with fourth segment usually fusiform..... ..... *Merragata* White

Genus *Merragata*

Key to the species of Merragata

A Fourth antennal segment not clubbed ..... *brevis* Champion

A′ Fourth antennal segment distinctly clubbed ..... B

B Disk of pronotum with narrow insignificant median groove; membrane of macropterous form milky white ..... *brunnea* Drake

B′ Disk of pronotum with a wide deep longitudinal furrow; membrane of macropterous form with fuscous spots ..... *hebroides* White

Merragata brevis Champion

This species was collected only from emergent vegetation in brackish or saline waters near the East Coast. Macropterous adults were taken in March, April, May, and August.

21 specimens collected from the following localities:
Cocoa, Indian River City, Mims, and Salt Lake.

Merragata hebroides White

This species apparently is not too common since it was collected only from the east coast area. Specimens were taken from a roadside ditch adjacent to the St. Johns River, a brackish slough adjacent to the Indian River, and one specimen from a calcareous roadside stream. Most specimens were macropterous whereas a few were brachypterous and all were dipped from algal mats near the shore. Adults were collected in April, June, and July.

47 specimens collected from the following localities:

Merritt Island, Mims, and Titusville.

Merragata brunnea Drake

Roadside ditches, lakes, rivers, sinkhole ponds, borrow pits, and other similar areas that contain calcareous water possess this species which is generally found adjacent to the shore on floating algal mats and on other debris on the water surface.

With the exception of *Hebrus consolidus* (Uhler), this species appears to be the most widely distributed hebrid in Central Florida. The brachypterous form is more common than the macropterous form. Adults were noted in January, February, May, July, October, November, and December and undoubtedly occur throughout the year.

58 specimens collected from the following localities:

Center Hill, Coleman, Holly Hill, Indian River City, Mims, Oak Hill, Orlando, Ormond, Titusville, and Union Park.

Genus *Hebrus*

Key to the species of Hebrus

A Apex of scutellum notched ..... B
A′ Apex of scutellum not notched C
B Narrow white line extending from base of both clavus and corium; antennal segment 3 equal to 5 with 4 much shorter..... *buenoi* Drake and Harris
B′ Larger triangular white area at base of clavus; antennal segment 3 longer than either 4 or 5 ..... *burmeisteri* L. and S.
C Base of clavus with distinct white triangular spot ..... *consolidus* Uhler
C′ Base of clavus with indistinct pale spot or none..... *concinnus* Uhler

Hebrus buenoi Drake and Harris

Specimens were collected from an area adjacent to a salt marsh, algal mats in brackish waters of a roadside drainage ditch, the damp shores of lakes, and from a damp area in a cypress swamp. Until recently this species was thought to be *H. bilineatus* Champion which it resembles but my specimens were compared with the type of *bilineatus* and were dissimilar. Considerable superficial variation exists between specimens of *buenoi* collected in Michigan and in Florida. All adults were macropterous and were noted from January through June.

27 specimens collected from the following localities:

Cocoa, Mims, Orlando, Pine Castle, Slavia, and Winter Park.

Hebrus burmeisteri L. and S.

This species was collected from roadside ditches and a calcareous spring and apparently is somewhat rare in this general area. Only macropterous adults were taken and these in January, April, October, and November.

6 specimens collected from the following localities:

Center Hill, Titusville, Wekiwa Springs, and Wildwood.

Hebrus concinnus Uhler

Several nice series of this species were taken, only from Orlando and vicinity, around the damp margins of a lake and a fluctuating pond. All adults were macropterous and were noted all months of the year except March, August, and September.

54 specimens collected from the following localities:

Orlando and Pine Castle.

Hebrus consolidus Uhler

This species is the most commonly seen Hebrid and was noted in roadside ditches, calcareous stream banks, shores of lakes, cypress swamps, and other damp areas. The macropterous form is more common than the brachpterous form but many of the latter were collected. The brachypterous form was initially described by Porter (1954) from some of these specimens. Adults were noted every month except August and September.

102 specimens collected from the following localities:

Center Hill, Cocoa, Floral City, Geneva, Holly Hill, Mims, Orlando, Titusville, Wekiwa Springs, and Wildwood.

Family Ochteridae
(Velvety Shore Bugs)

Genus *Ochterus* Latrielle

Key to the species of Ochterus

A Side margins of pronotum with pale spot near front angle..... B
A′ Side margins of pronotum concolorous .....*banksi* Barber
B Clavus completely yellow .....*flaviclavus* Barber
B′ Clavus concolorous with corium .....*americanus* (Uhler)

Ochterus americanus (Uhler)

This, the most common Ochterid, was often noted along the damp margins of lakes, roadside ditches, and other wet, mucky areas. Adults evidently occur throughout the year as specimens were collected every month except April, September, and November.

45 specimens collected from the following localities:

Christmas, Cocoa, Cocoa Beach, Kissimmee, Maitland, Mims, Oak Hill, Orlando, Pine Castle, Slavia, Union Park, and Wekiwa Springs.

Ochterus flaviclavus Barber

This is an exceedingly rare species in collections. The majority of the specimens were taken from mucky situations close to calcareous springs.

The edge of a salt-marsh and a cypress swamp each yielded single specimens. Adults were collected in March, June, July, and August.

5 specimens collected from the following localities:

Altamonte Springs, Christmas, Oak Hill, Orlando, and Wekiwa Springs.

Ochterus banksi Barber

Schell (1943) reports this species as represented in the Francis Huntington Snow collection from Capron, Florida.

Family Gelastocoridae

(Toad Bugs)

Key to the genera of Gelastocoridae

A Front tarsi with two claws; eyes large and prominent ..... *Gelastocoris* Kirkaldy

A′ Front tarsi with one claw; eyes small, sessile, and not prominent ..... *Nerthra* Say

Genus *Gelastocoris*

Gelastocoris oculatus (Fabricus)

This species exhibits a great deal of variation both in size and color, and was collected from almost any damp area, especially those adjacent to lakes, ponds, rivers, and roadside ditches. Adults were taken every month of the year. *G. subsimilus* Blatchley and *G. barberi* Bueno are synonyms.

188 specimens collected from the following localities:

Christmas, Cocoa Beach, Indian River City, Kissimmee, Maitland, Mims, Narcoosee, Oak Hill, Orlando, Osteen, Oviedo, Pine Castle, Salt Lake, Sanlando Springs, Sarasota, Slavia, Titusville, Union Park, Wekiwa Springs, and Winter Park.

Genus *Nerthra*

Key to species of Nerthra

A Hemelytra fused together; ocelli present ..... *stygica* Say

A′ Hemelytra not fused together, ocelli absent..... *rugosa* (Desjardins)

Nerthra stygica Say

Adults and nymphs were collected from a roadside ditch, a damp area adjacent to a lake, and from the base of emergent vegetation growing in the brackish waters of the Indian River. Undoubtedly the reason this species is somewhat rare in collections is because it usually remains motionless when discovered or disturbed. Adults were noted in April, May, June, July, September, October, and December.

28 specimens collected from the following localities:

Christmas, Indian River City, Orlando, and Oviedo.

Nerthra rugosa (Desjardins)

Blatchley (1926) records the taking of two specimens from the margin of Arch Creek, Florida. *Glossoaspis brunnea* Blatchley is a synonym.

Family Saldidae

(Shore Bugs)

Key to the genera of Saldidae

A Anterior lobe of pronotum with two large conical tubercles ..... *Saldoida* Osborn
A′ Anterior lobe of pronotum without large conical tubercles ..... B
B Membrane with five longitudinal looped cells.....*Pentacora* Reuter
B′ Membrane with four longitudinal looped cells C
C Two distinct veins in corium with inner vein forked toward apex, its branches reaching membranal suture .....*Saldula* VanDuzee
C′ Both veins in corium completely obsolete .....*Micracanthia* Reuter

Genus *Saldoida*

Key to the species of Saldoida

A Posterior angles of pronotum sub-acute to acute.....*cornuta* Osborn
A′ Posterior angles of pronotum obtuse .....*slossoni* Osborn

Saldoida cornuta Osborn

This species was taken only from a roadside ditch, the damp shores of a hammock-region lake and fluctuating pond, and apparently is less common than *slossoni*. Except for one macropterous specimen, all were brachypterous and were collected in January, February, June, and July.

21 specimens collected from the following localities:
Christmas, Maitland, and Orlando.

Saldoida slossoni Osborn

The shores of many hammock-region and sand-shore lakes yielded specimens of this species. *Slossoni* was also taken in a cypress swamp and single specimens were noted from the shores of a sand-bottomed stream and from the edge of a salt marsh. Eight macropterous specimens were collected with the brachypterous form more common. Adults were collected in February, April, June, July, and November.

50 specimens collected from the following localities:
Christmas, Maitland, Orlando, Pine Castle, and Titusville.

Genus *Pentacora*

Key to the species of Pentacora

A Species with dorsal surface shining and many long erect hairs ..... *hirta* (Say)
A′ Species with dorsal surface dull and short erect setae..... B
B Lateral margins of pronotum with short erect setae ..... *signoreti* (Guerin)
B′ Lateral margins of pronotum without setae .....*sphacelata* (Uhler)

Pentacora hirta (Say)

Common in salt marshes where it abounds among the pickleweed and other vegetation. A few specimens were taken along the sandy shores of

the Atlantic Ocean and a salt lake. Adults occur throughout the year. *P. pellita* (Uhler) is a synonym.

25 specimens collected from the following localities:

Cocoa, Cocoa Beach, Mims, Sarasota, Shiloh, and Titusville.

Pentacora signoreti (Guerin)

This agile species haunts the bare salt flats of the salt marshes with the tiger beetles which they appear to mimic both in form and method of flight. A few specimens were taken along the sandy shores of the Atlantic Ocean. Adults were collected in April, May, and June but occur throughout the year.

18 specimens collected from the following localities:

Cocoa, Mims, and Titusville.

Pentacora sphacelata (Uhler)

Common in the salt marshes where it occurs on damp thinly vegetated areas and along the shores of salt-water lagoons. It has also been noted from the sandy shores of the Atlantic Ocean. Adults were collected in May, June, and July.

20 specimens collected from the following localities:

Cocoa, Cocoa Beach, and Sarasota.

Genus *Saldula*

Key to the species of Saldula

A Outer margins of pronotum with a pale stripe.....*coxalis* (Stal)
A′ Outer margins of pronotum concolorous with pronotum..... B
B Anterior tibia with a solid basal dark stripe; embolium with one or more dark areas beyond the base .....*pallipes* (Fabricus)
B′ Anterior tibia with the basal dark stripe interrupted before the middle; embolium pale except at base.....*opacula* (Zetterstedt)

Saldula coxalis (Stal)

Barber (1914) recorded *Acanthia xanthochila* var. *limbosa* Horvath from Florida but it is probable that his specimens were *S. coxalis* since *S. xanthochila* var. *limbosa* is known only from Europe.

Saldula pallipes (Fabricus)

This is the most widely dispersed Saldid in Central Florida as it is abundant in salt marshes, along damp shores of lakes and streams, and almost any damp area. A few specimens were taken along the sandy shores of the Atlantic Ocean. Frequently this species becomes so abundant in the salt marshes that it outnumbers all of the *Pentacora* species. Adults were taken every month of the year. *S. interstitialis* (Say) and *S. reperta* (Uhler) are synonyms.

33 specimens collected from the following localities:

Cocoa, Cocoa Beach, Oak Hill, Orlando, Sarasota, Titusville, Union Park, and Wekiwa Springs.

Saldula opacula (Zetterstedt)

The U. S. National Museum possesses one specimen of this bog inhabiting species from Paradise Key, Florida.

Genus *Micracanthia*

Drake and Chapman (1952, 1953) present a detailed description of these species and their habits.

Key to the species of Micracanthia

A Antennal segments 3 and 4 swollen and densely pubescent; apical portion of scutellum tumid and shiny black ..... *pumpila* Blatchley

A′ Antennal segments 3 and 4 not swollen or densely pubescent; scutellum not tumid or shiny ..... B

B Antennal segment 2 shorter or at most sub-equal to segment 3..... *husseyi* Drake and Chapman

B′ Antennal segment 2 distinctly longer than segment 3 C

C Generally smaller species; dorsal surface much lighter; membranal area dull white with few small fuscous spots; embolium usually pale throughout its length .....*humilis* (Say)

C′ Generally larger species; dorsal surface very dark; membranal area completely fuscous; embolium with two pale areas separated by a dark area ..... *floridana* Drake and Chapman

Micracanthia pumpila Blatchley

This species appears to haunt salt marshes where it abounds on damp and flooded areas beneath pickleweed and dead man's finger. It was usually collected by a dipper while searching for mosquito larvae. This technique was also successfully used in the New Jersey salt marshes to obtain large numbers of the rare *M. hungerfordi* (Hodgden). Specimens also were taken from damp areas adjacent to brackish streams. The brachypterous form of *pumpila* is quite common. Adults were collected from February through August.

55 specimens collected from the following localities:

Cocoa, Mims, Oak Hill, Shiloh, and Titusville.

Micracanthia husseyi Drake and Chapman

The singular habit of lurking on grass which protrudes above the water line is distinctive of this species. It was taken from vegetation in fresh, brackish, and salt water and from floating logs in cypress swamps. When these swamps dried up, this species was observed on the damp ground for the first time. In the past this species was confounded in collections with *M. pumpila* and *humilis*. Adults were collected all months except January, September, and November.

170 specimens collected from the following localities:

Cocoa, Indian River City, Mims, Orlando, Salt Lake, and Titusville.

Micracanthia humilis (Say)

Apparently a fresh water habitat is preferred by this species since the writer has only once collected it in the vicinity of salt water. It was collected principally among the thin vegetation on the damp shores of streams, lakes, sinkhole ponds, and other damp areas. Specimens were also taken from the shores of cypress swamps. It is easily the most widely dispersed Saldid in Central Florida next to *Saldula pallipes*. Adults were collected every month but September.

55 specimens collected from the following localities:

Christmas, Cocoa, Indian River City, Kissimmee, Maitland, Mims, Orlando, Osteen, Pine Castle, Union Park, and Wekiwa Springs.

Micracanthia floridana Drake and Chapman

Collected only from a deserted wooden boat dock that extends out in the Wekiwa River which originates from a typical Florida calcareous spring. Adults and nymphs move about on the damp wood adjacent to the water surface and are easily collected by hand. The writer has taken this species twice in New Jersey in essentially the same type of environment, i.e., on stumps and logs protruding above the water surface and above the water line on a cement wall beneath a bridge. Former Florida records of *M. quadrimaculata* (Champion) actually belong to *floridana*. Adults were collected only in May, June, and July.

54 specimens collected from the following locality: Wekiwa Springs (Apopka.)

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A NEW GENUS OF GERRIDAE (HEMIPTERA) FROM SOUTH AMERICA[1]

Herbert B. Hungerford and Ryuichi Matsuda

This undescribed gerrid has been in our collection at the University of Kansas for many years. For several years it was represented by four females bearing the label "Bolivia, S. A., Santa Cruz, J. Steinbach." One of these the senior author sent to the late Professor Teiso Esaki, Fukuoka, Japan, for his opinion in 1932, and made the suggestion that if it were new would be glad to send them all to him for description. However, perhaps because we had only females, he did not describe the species but wrote "This species may represent a new genus, which may be separated from *Telmatometra* 1) in the different shape of eyes, being more slender in dorsal aspect and much more backwardly protruded; 2) in the position of the insertion of the antennae, being not caudad of the anterior margin of eyes; 3) and in the longest first antennal segment etc. There is no described genus which may include this species."

In 1938 our museum received eight males and eight females of this species collected by A. M. Olalla in Bolivia, South America, and at long last we are describing this interesting new species. We still have no winged specimens.

Trepobatoides gen. nov.

Small and elongate ovate in shape. Head between eyes longer than wide, widened posteriorly. Eyes oblong, covering anterolateral angle of pronotum. Antennal cavities located in front of anterior margins of eyes. Antennae slender, first segment longer than two following segments together, especially so in female; relative length of second to first greater in male than in female. Rostrum extending beyond prosternum.

Pronotum small, narrower than head including eyes. Mesonotum with posterior margin feebly concave. Metasternum entire, without omphalium, a little longer than second ventral abdominal segment. Anterior margins of first and second abdominal tergites distinct, produced anteriorly. Male genitalia with distinct but simple paramere. Suranal plate simple.

This genus is related to *Telmatometra* and *Trepobates* but peculiar in the following characters:

1. The first antennal segment is longer than the second and third segments together in both sexes, much longer than the second and third combined in the female.

2. The relative length of the second to the first antennal segment is distinctly longer in the male than in the female.

3. The relative length of the first to the second tarsal segment in the middle leg is about 2:1; whilst the same never exceeds 1.5:1 in *Trepobates* and *Telmatometra*.

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[1] Contribution No. 995 from the Department of Entomology, University of Kansas. This report is by-product of a project conducted with aid of a grant from the National Science Foundation.

The black median stripe on the head occurs also in *Trepobates* but not in *Telmatometra*, and the first antennal segment is relatively longer in *Trepobates* than in *Telmatometra*. These characters suggest closer relationship to *Trepobates* than to *Telmatometra*.

Type species of the genus :

Trepobatoides boliviensis Hungerford and Matsuda

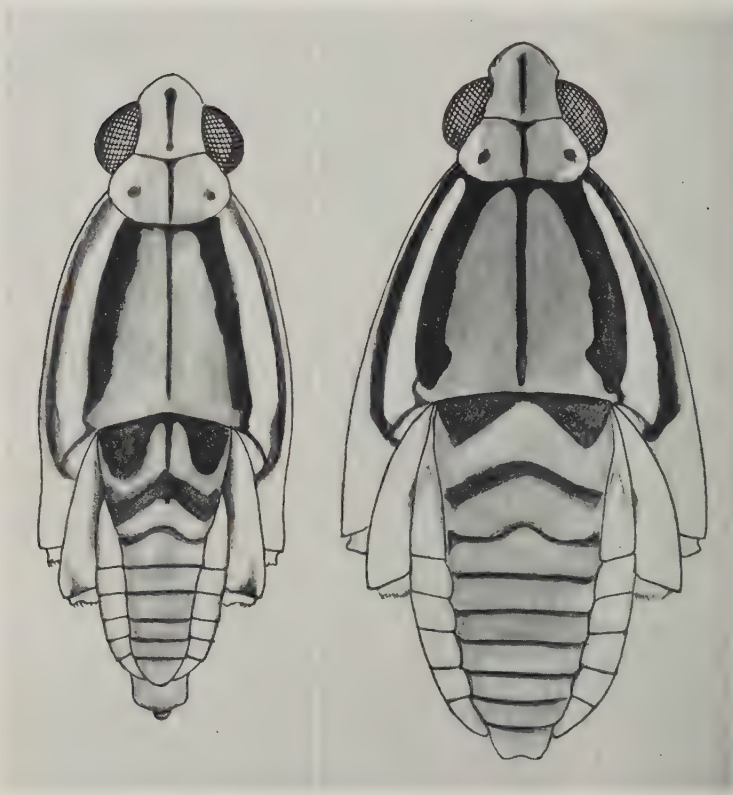


Plate I. *Trepobatoides boliviensis* Hungerford and Matsuda. Left side male, right side female.

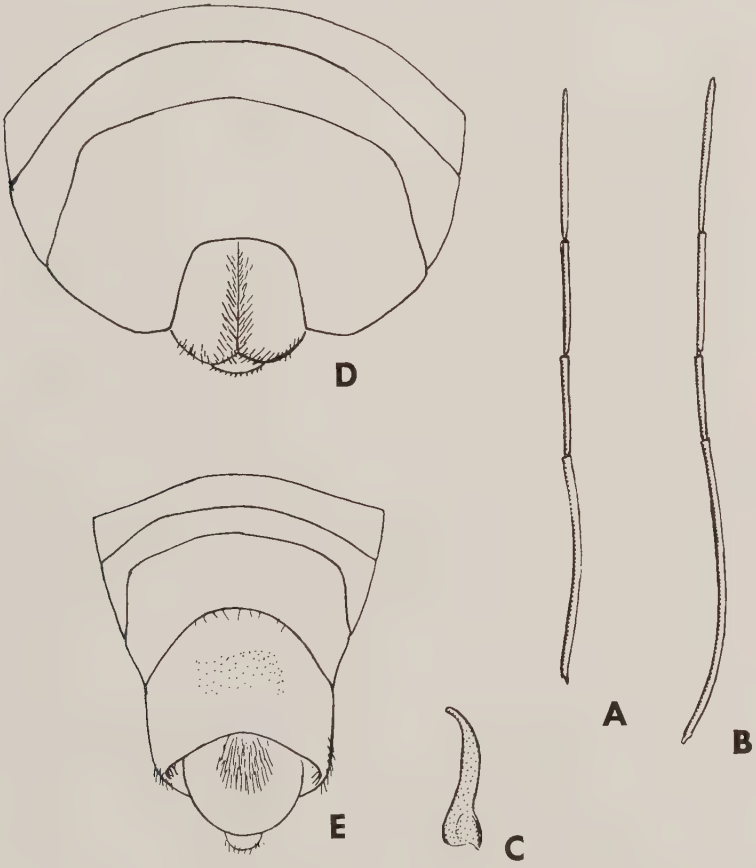
Trepobatoides boliviensis sp. nov.

(Plate I; Figures A - E)

SIZE: Apterous males: 3.57 to 3.78 mm. long.; 1.6 mm. greatest width. Apterous females: 3.36-4.45 mm. long; 2.1 mm. greatest width.

COLOR: Pale testaceous with black stripes, sides and venter covered with a frosty pile (see plate 1). The white lateral stripes of mesothorax are due

to frosty or silvery pile on pale testaceous background. Median black stripe on head and round dots on pronotum sometimes reduced or nearly obliterated. Beak pale testaceous except distal segment which is shiny black. First antennal segment testaceous above, brown beneath, other segments brown. Legs testaceous, darker apically; front femur brown beneath.



Trepobatoides boliviensis Hungerford and Matsuda

Fig. A. Antenna of male.
Fig. B. Antenna of female.
Fig. C. Right paramere.
Fig. D. Ventral view of female apical abdominal segments.
Fig. E. Ventral view of male apical abdominal segments.

Structural Characteristics: Antennae not quite as long as body. Relative length of antennal segments in male : 1st : 2nd : 3rd : 4th :: 57 : 21 : 28 : 40; in female : 70 : 22 : 26 : 38. First antennal segment slender and slightly curved. Beak stout, third segment extending onto mesosternum.

TABLE 1. The Relative Length of the Leg Segments in a Male.*

	Femur	Tibia	Tarsal seg. 1	Tarsal seg. 2	Total length of tarsus
Front leg	70	50	6	18	24
Middle leg	135	200	60	30	90
Hind leg	165	78	13	16.5	29.5

* Measurements are ocular micrometer units—20 units = 0.42 mm.

Middle leg longest; middle femur stoutest; middle first tarsal segment twice as long as second. Ventral abdominal segments of male short except last one, which is about as long as two preceding segments together; first genital flattened, slightly depressed and longer than last abdominal; last abdominal plus genital segments longer than rest of abdomen. Ventral abdominal segments of female short except last, which is as long as two preceding segments together; genital segments more or less withdrawn ventrally. Male paramere shaped as in fig. C.

Comparative Notes: The nearest relatives appear to be in the genus *Trepobates*.

Location of Types: Holotype, allotype and paratypes (7 males and 7 females) bear the labels "Bolivia, S. A. R. Chapare, March 1938, A. M. Olalla" and "Road between Todos Santos and Palmer;" also four female paratypes labeled "Bolivia, S. A., Santa Cruz, J. Steinbach." This type series is in the Francis Huntington Snow Entomological Collection, University of Kansas.

NOTES ON *AEGIALOMYIA PSAMMOPHILA* (O. S.) (TABANIDAE: DIPTERA)[1]

R. L. Blickle
New Hampshire Agricultural Experiment Station, Durham

Ocean beaches on the east coast of Florida were examined for specimens of *Aegialomyia psammophila* (O. S.) during 1957. Adult flies were taken on Long Key, April 19; Winter Beach, May 3; Fort Pierce (Pepper Park), May 6; Vero Beach, May 6; Sebastian Inlet, Brevard County, May 14; and at the northern end of Cocoa Beach, May 18. Since this species has been recorded from Georgia (Philip, 1950), it probably occurs on all the beaches of the east coast of Florida. This fly was taken on every beach from Fort Pierce inlet to the Sebastian Inlet, and on the two beaches surveyed outside of this area.

The ocean beach in the Fort Pierce (Pepper Park) area is probably the type locality. The locality listed by Osten Sacken (p. 445, 1876) is Fort Capron, Florida. Aided by Mr. William Bidlingmayer the site of Fort Capron was located. It is indicated at the present time by a plaque on a granite stone on the "Old Dixie Highway" in the town of St. Lucie. This marker is on the west side of the Indian River, about three miles north of Fort Pierce. However, Osten Sacken (p. 445, 1876) states that the specimens were taken "on the sea beach". The sea beach east of the Fort Capron marker is approximately the beach area of Pepper Park. This may or may not be the exact location where the type specimens were taken.

A survey of the sand beaches along the Indian River from Sebastian to St. Lucie, Florida, was made, but no *Aegialomyia* were seen. The beaches along the river are narrow and subject to frequent inundation by tides and this may account for the failure to discover any of these flies in these habitats.

Aegialomyia psammophila was found on beaches which were frequented by bathers, i. e. at Cocoa, Fort Pierce, and Vero Beach, as well as on beaches seldom visited by people such as Long Key and Sebastian Inlet. The flies were more numerous on the less frequented beaches but were, nevertheless, common at Pepper Park, a public beach.

A few beaches on the west coast of Florida were examined with negative results, these areas being on Sanibel Island, Captiva Island, and at Chokoloskee.

The beaches, where the flies were found, are quite different in some respects. The one at Long Key was narrow, seldom four yards wide, and was not exposed to a great deal of tidal action. The other beaches examined were from ten to forty yards wide depending on the stage of the tide, these beaches being exposed to a great deal more tidal and wave action. The sand on the beaches from Sebastian Inlet south was loose and contained considerable shell. The sand at Cocoa Beach was firm and had a tendency to pack, in fact, automobiles were driven along this beach. It is seldom if ever that cars can be driven on the southern beaches.

The adult flies seem to prefer the drier parts of the beach above the high tide line. A few were seen on the wet sand but they porbably flew

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[1] Contribution (No. 52) from the Entomological Research Center, Florida State Board of Health.

there when they were disturbed by the observer. On windy days they could be found resting on the seaweed litter on the upper part of the beach and in several instances they were noted crawling down into the piled up seaweed. At Long Key they were on all parts of the beach, probably due to the fact that the beach was narrow.

While walking along the beach one would disturb the flies so that they would fly for a short distance, alight and face the observer. If a fly was disturbed repeatedly it would fly out over the ocean before alighting on the sand again. These horseflies flew close to the ground, usually within two feet of the sand. Due to the low flying and the very bright light conditions it was difficut to follow the flight when it was over the ocean or for more than twenty yards. The habits of this fly, when disturbed, resemble those of the Cicindelidae. In fact, the position of the fly at rest, the color markings on the wings, and the size of the fly give them the habitus of *Cicindela dorsalis media* Lec.[2] also found on these beaches. This similarity has been remarked by others (Haeger, 1948). Another insect found on some of the beaches in association with the horseflies was an Asilidae, *Laphystia litoralis* Curran.[2] These flies, at first glance, resemble the *Aegialomyia* in flight and resting habits, however, they are one-third smaller. All of the above insects are white in appearance as is often the case with psammophilic insects.

Many observations were made to determine the habits of the flies. They were seen resting on the sand and on the seaweed litter, or flying when disturbed. In only one instance was any other action noted. A female *A. psammophila* was observed moving about on a mass of seaweed litter. Since the abdomen of the fly was swollen it was thought that it may have been gravid. The fly kept the tip of its abdomen in contact with the seaweed as it crawled about. After moving about on this material for a distance of about three feet the fly moved to the sand, then crawled for a distance of fifteen feet, pausing momentarily every two or three feet. The course taken was tortuous since the female was crawling between scattered piles of seaweed. The tip of the abdomen was in contact with, or very close, to the sand during the entire period. The time elapsed during the entire action was approximately fifteen minutes. The action terminated when the fly was disturbed by another insect and flew away.

Several times a female fly came to rest on the bare leg of the observer, but there was no attempt to obtain a blood meal.

A search for the immature stages of *Aegialomyia psammophila* resulted in the finding of one larva and one pupal case. Both of these were taken from the beach on Long Key. The pupal case was near the upper margin of the beach. The larva was taken from the moist sand beneath a pile of seaweed approximately two feet from the ocean. The larva was two inches below the surface of the sand. Many amphipods and earthworms were found in the sand from which the larva was taken.

The larva was placed in a plastic pill box and transported to the laboratory. Beach sand and a small amount of seaweed were placed in the pill box with the larva. The sand was kept moist by adding tap water as needed. Small pieces of frozen horsemeat were given to the larva as food

[2] Identification by Insect Identification Laboratory, Agricultural Research Service.

but did not seem to be satisfactory. Phorid larvae, *Megaselia* sp., were then used as food and proved to be acceptable to the larva. The larva, taken on April 19, was 22 mm. long. The larva moulted once, a cast skin being found in the sand on June 24. It changed to a pupa on July 1, the length of the larva being 25 mm. at the time of pupation. A male fly emerged on July 12.

The larva of *A. psammophila* is white and there are no distinguishing markings. The anal segment is truncate and resembles the larva of *Haematopota* in this respect.

The pupa, in general appearance, resembles those of *Tabanus,* however, the tubercles of the pupal aster are elongate with the apical three-fourths greatly narrowed. The length of the tubercles is approximately five times the basal width. The pre-anal fringe is uninterrupted and composed of twenty-two spines, those on the lateral margin are short and those on the ventral part long. The dorso-lateral combs are composed of six spines. The annular fringe on the abdominal segments is made up of alternate long and short spines. The long spines are approximately one-half the length of the segment over which they extend. The fringe is denser on the dorsal and lateral parts of the segment. The first abdominal segment has only six long, widely spaced spines on the dorsal surface, and three long spines on each side just posterior to the spiracle.

A pupal case taken from sand on beach at Long Key agrees in every respect with the male pupa except one. The pre-anal fringe on the *Aegialomyia* pupal case is interrupted leaving a gap on the ventral portion and dividing the fringe into two parts of about eight spines each. Since this condition, the interruption of the anal fringe, occurs in both *Tabanus* and *Haematopota* female pupal cases, this pupal case is considered to be one from which a female fly had emerged.

The combination of long, slender, terminal parts of the tubercles of the aster and the long hair fringe on the abdominal segments are the main differences which separate these from other Tabanid pupae.

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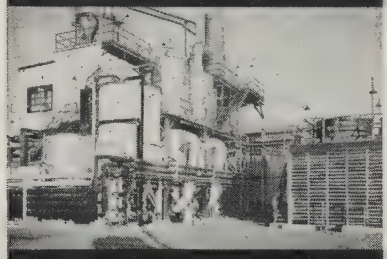

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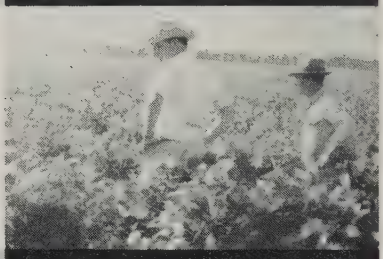

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OBSERVATIONS ON BIOLOGY AND ECOLOGY OF *TORTRIX IVANA* FERNALD (LEPIDOPTERA: TORTRICIDAE), AS A PEST OF CELERY IN THE FLORIDA EVERGLADES, AND NOTES ON ITS CONTROL [1]

W. G. Genung [2] and N. C. Hayslip [3]

The tortricid moth, *Tortrix ivana* Fernald, has been observed at various times in celery plantings in the Florida Everglades. During the spring of 1948 Hayslip (1948) found larvae of this moth causing severe injury in some plantings. In view of the serious nature of the infestation, it was considered desirable to study the life history and ecology of this little known species. The data obtained are from insectary studies and field observations. Population trends were derived from light trap catches of adult moths at the Everglades Experiment Station. Population trends have been correlated with the celery production period of the year, based on carlot shipments, to ascertain when the crop is most likely to be infested.

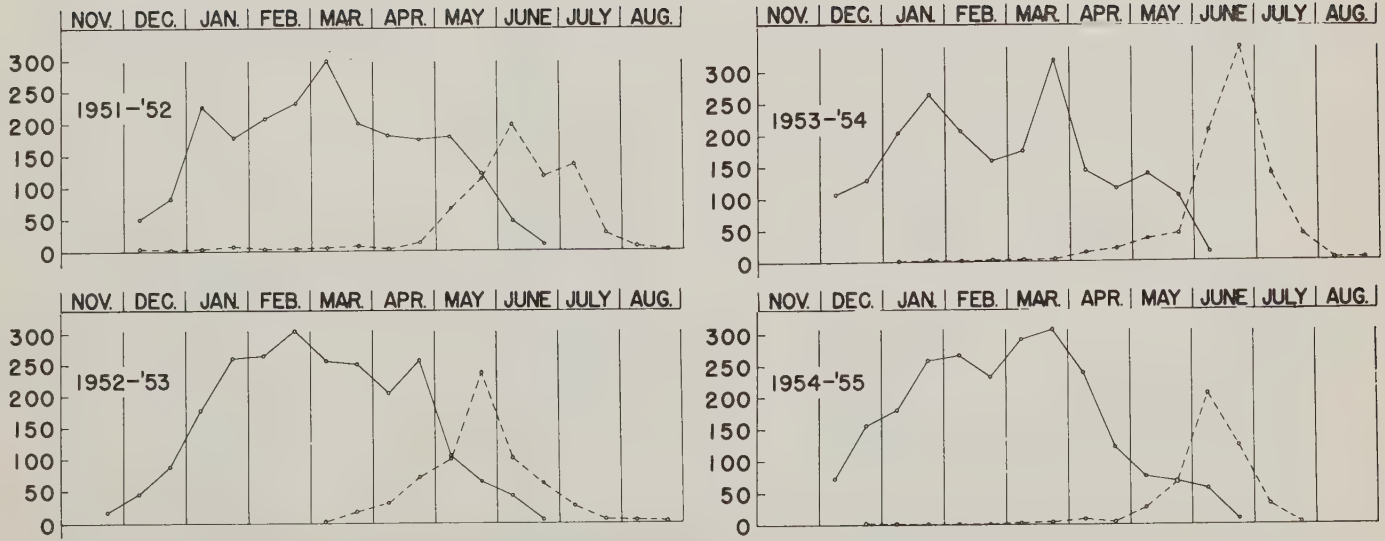
Literature Review

The literature on *Tortrix ivana* Fernald is very brief. Hyslop (1934) mentions that the species was described in 1901 from Florida specimens, and that the insect was not recorded again until 1931, when severe damage was reported to rose foliage and flower buds on Long Island, New York. This tortricid was next reported in 1933 by Clarence O. Bare (1934), attacking celery in the Everglades. The late R. N. Lobdell, then entomologist at the Everglades Experiment Station, and Bare examined a field southeast of the station where an infestation of the celery leaf tier, *Phlyctaenia rubigalis* (Guen.), was suspected. A severe infestation of *Tortrix ivana* Fernald was found. Bare expressed concern over the possibility of the moth becoming a major pest of celery in the Everglades. However, the species was not observed again attacking this crop, until Hayslip (1948) reported a severe infestation of a tortricid on celery in the Everglades, a decade and a half after the initial report from the area. Specimens submitted by Hayslip to the Division of Insect Identification, Bureau of Entomology and Plant Quarantine, were determined only as Tortricidae, possibly *Platynota* sp. Subsequent material submitted by the writers in 1951 was determined by J. F. Gates-Clark of the above division to be *Tortrix ivana* Fernald. Since 1948, light to moderate numbers of the insect have been observed yearly in late celery plantings in the Everglades. Genung reported studies on this tortricid in 1951-53. According to Wilson and Hayslip (1951), this species has not attacked celery in the Sanford area. In early April, 1956, light damage by this species was observed in the Everglades, and the large numbers of adults present indicated that before the season was over severe in-

[1] Florida Agricultural Experiment Station Journal Series, No. 739.

[2] Associate Entomologist, Everglades Experiment Station, Belle Glade, Florida.

[3] Entomologist, Indian River Field Laboratory, Fort Pierce, Florida.



Figures 1-4.—Population trends of *Tortrix ivana*, broken line, in relation to celery production season, solid line. Mean number moths and mean number carlot shipments. Seasons 1951-52, 1952-53, 1953-54, 1954-55.

jury could result. However, serious attacks did not materialize, probably due to partial control of both adults and larvae by regular applications of parathion.

Distribution, Host Range and Life History

Little is known of the distribution of this tortricid. The species has been of economic importance in Florida and New York, indicating that the insect can tolerate highly variable conditions and may have a wide distribution. The writers have collected or noted the adults occurring at lights over most of the peninsular portion of Florida, from Miami and Belle Glade to St. Augustine and Gainesville.

Host Studies: Since host preference and host specificity could be important factors in control, considerable time was spent in inspection to determine the natural host plants in the area. Initial inspections were made on wild and cultivated plants related to celery, but no infestations were found on other umbelliferous plants growing in the vicinity. The scope of the inspection work was then broadened to include all the plant species commonly growing in the agricultural area of the Everglades, including both wild and cultivated plants. Immature stages of *Tortrix ivana* Fernald were found on 15 plant species representing 10 widely divergent plant families. Two additional plant families and three species are listed in the sparse literature on the moth (Bare, 1934; Hyslop, 1934). This brings the number of host species reported under field conditions to 18. Additional plants representative of other families and species artificially infested with this insect were acceptable to the larvae; some of the insects completed their development in each instance. The number of recorded hosts from the standpoint of families and species is not exceptionally large. However, the plant species that are acceptable hosts of *Tortrix ivana* Fernald represent families that practically span the spermatophytes from Poaceae (Graminae) to Carduaceae (Compositae).

Except where parasitism prevented, eggs and larvae found in the field have been reared to the adult stage in order to eliminate the possibility of misidentification. (Host data are summarized in Table 1.)

Character of Injury: Damage to celery caused by *Tortrix ivana* Fernald resembles that of the celery leaf tier. Young larvae feeding on the petioles cause lengthwise grooves which they cover with fine silken webbing. Some larvae bore holes into the petioles and work entirely within the protection of the stalk. These worms appear to inflict injury equivalent to much larger larvae. Hayslip (1948) reported that one planting was observed in which losses amounted to 50 percent or more of the crop in some blocks.

Description of Stages: Egg—The light greenish-yellow eggs are deposited in irregular, shingled masses on the upper and lower leaf surfaces, and occasionally on the petiole. Egg masses may vary from less than a half dozen to as many as 50 or 60 eggs. Most field-collected masses observed did not exceed 25 eggs. Five females, which were under close observation, laid an average total of 105 eggs with a minimum of 99 and a maximum of 115. The number of masses per female ranged from two to six. The incubation period varied from five days to nearly two weeks in this study, the average hatching time being approximately seven days.

TABLE 1.—Host Plants of *Tortrix ivana* Fernald.

Common Name	Botanical Name	Family	Stage of *T. ivana* found	Remarks
	(A) Plant Hosts Found in Everglades.			
Spiny amaranth	*Amaranthus spinosus* L.	Amaranthaceae	egg	Reared to adult
Pig Weed amaranth	*Amaranthus hybridus* L.	Amaranthaceae	egg	Reared to adult
Water hemp	*Acnida* sp.	Amaranthaceae	egg	Reared to adult
Fringed quickweed	*Galinsoga ciliata* Raf. (Bl.)	Carduaceae (Compositae)	larvae	Reared to adult
Celery	*Apium graveolens* L.	Amanaceae (Umbeliferae)	larvae	Reared to adult
Nutgrass	*Cyperus* sp.	Cyperaceae	larvae	Reared to adult. Some parasitized
Vaseygrass	*Paspalum urvillei* Stent.	Poaceae (Gramineae)	larvae	Parasitized
Alfalfa	*Medicago sativa* L.	Leguminosae	larvae	Parasitized
Sweet potato	*Ipomea batatas* L.	Convolvulaceae	larvae	Adult flushed while ovipositing
Wandering Jew	*Commelina diffusa* Burm.	Commelineace	larvae	Adult flushed while ovipositing
Balsam apple	*Momordica charantia* L.	Cucurbitaceae	larvae	Adult flushed while ovipositing
Southern pea	*Vigna sinensis* (L.) Savi.	Leguminosae	larvae	Reared to adult
Southern pea	*Vigna sinensis*	Leguminosae	adults	Numerous
Collards	*Brassica oleracea* var. *acephalica* D. C.	Cruciferae	adults larvae	Adults abundant A few larvae
Cabbage	*Brassica oleracea* var. *capitata* L.	Cruciferae	adults	Three larvae did not complete development. A few adults.

Table 1 (Cont.)

Common Name	Botanical Name	Family
	(B) Plant Hosts Reported in Literature	
Marsh elder	*Iva imbricata* L.	Carduaceae (Compositae)
Rose	*Rosa odorata* L.	Rosaceae
Rabbit tobacco	*Gnaphalium obtusifolium* L.	Carduaceae (Compositae)
	(C) Plants Acceptable when Artificially Infested	
False Bishops weed	*Ptlimnium capillaceum* (Michx.)	Raf. Amanaceae (Umbeliferae)
Ramie	*Boehmeria nivea* L.	Urticaceae
Corn	*Zea mays* L.	Poaceae (Gramineae)
Pangolagrass	*Digitaria decumbens* Stent.	Poaceae (Gramineae)
St. Augustinegrass	*Stenotaphrum secundatum* (Walt) Kuntze	Poaceae (Gramineae)
Paragrass	*Panicum purpurascens* Raddi	Poaceae (Gramineae)

Larva—Just prior to eclosion the embryonic caterpillars can be seen within the eggs. The light-colored, black-headed larvae that emerge from the eggs move out quite rapidly from the shell mass, frequently dropping to lower levels by means of suspension threads. Small, irregular holes are eaten in the leaves by the young caterpillars. The newly hatched larvae become darker with age through ingestion of chlorophyl bearing materials. Early in their development the young larvae begin to web the leaves together for protection. Many larvae move to the celery petioles, but on less succulent plants the feeding appears to be confined entirely to the foliage. The fully grown larvae are from 12 to 18 millimeters in length, and, in May, they have been observed to require 16 to 20 days to attain full growth.

Pupa—The prepupa moves out to the leaf area where it webs itself in for transformation to the pupa. The greenish to brownish, slender pupae average about 9 millimeters in length and become darker with age. The pupa is attached to the leaves by means of a well developed cremaster, and upon removal readily re-attaches to any surface that is not too smooth. About one week was required to complete the pupal stage in May.

Adults—The adult moth is a typical tortricid, having the usual bell-shaped outline when the wings are folded. The moths are from 5 to 9.5 millimeters long, averaging about 8 millimeters. They are light brown or tan with variable darker brown markings on the forewings. The hind wings are greyish. Consistent differences in markings between the sexes were not observed. The tip of abdomen, apical margin of the forewings and both the apical and anal margins of the hind wings are fringed. Eyes are prominent and antennae are filiform; the latter has scales that sometimes give these organs a serrated appearance. The tibia are armed with spur-like outgrowths. The moths are often plentiful at light, where a noticeable decline in numbers can be observed in late summer. The insect is very amenable to cage rearing. Three generations were reared from a collection of larvae from the field. Mating habits probably are largely nocturnal. However, the moths have been observed in copula during daylight on several occasions. The insects seem to live only one to three days after completing oviposition. The adults are erratic fliers with a zig-zag or wavering flight habit.

Number of Generations: Because of the difficulty of keeping sufficient numbers of the insects alive during the summer population decline, it was impossible to determine the exact number of generations during the year. During the spring and summer 31 to 44 days were required to complete a generation from egg to adult, but a longer period is probably required during the winter months. More than four years of studying the population trends indicate that the late summer, fall and winter generations normally occur under conditions of low population. The number of generations probably would be more during exceptionally mild winters.

Natural Enemies

Parasites: A bethylid parasite reared from field collected larvae was determined to be *Goniozus platynotae* Ashm. by Dr. C. F. W. Muesebeck. The adult wasps emerge from pyriform cocoons constructed beside the shriveled remains of the dead host, within webbed or rolled leaves. Six of these parasites emerged from two cocoons. The wasps are black with

yellow legs, ant-like and rather elongate in form. An egg parasite, *Trichogramma* sp., was reared from field collected egg masses. Bare (1934) reports rearing *T. minutum* from eggs collected near Belle Glade in 1933. No predators or diseases of *Tortrix ivana* Fernald have been observed in the field or insectory. However, the rapid decline in population in late summer may be due to disease. Larvae in cages at this time died off with a rapidity suggestive of an epizootic.

Population Studies

Population trends of *Tortrix ivana* Fernald have been studied through the use of light traps since 1951. The purpose of this work was to observe the seasonal occurrence of the species and its correlation with the celery production season. Catches were made about twice weekly when weather conditions were favorable. For determining actual population levels by this means, there is little purpose in operating traps during exceptionally cold or stormy periods. Counts were averaged for bi-weekly periods for plotting graphs (Figures 1, 2, 3 and 4). The correlative data on celery production was plotted from carlot shipments over two-week periods from the Belle Glade area. The data obtained thus far indicate that *Tortrix ivana* Fernald does not ordinarily reach its peak population until the celery harvest period is nearly over, and that usually no population of conseqeunce occurs until late in the season. These data have been confirmed by inspections in growers fields and experimental plantings. The larval population peak would be two to three weeks earlier than that of the adult peak.

The 1948 infestation reported by Hayslip was a little earlier than normal, occurring from mid to late April. However, the severe infestation reported by Bare (1934) occurred in January, indicating that under certain conditions abnormally large populations can develop during the winter. An examination of area weather reports failed to show any affects directly attributable to high winter temperature. If high temperature had been important in this instance, the key period should have been the month previous to the appearance of the infestation (December, 1932). The minimum temperatures for December were from 10 to 14.5 degrees higher than the average for the four-year period over which the present population study was made. The December, 1949, minimum temperatures were even higher than those in 1932, without a high population developing in January. The mean temperatures also did not seem to be of critical importance. Rainfall was so variable under all conditions that it was not considered an important factor in relation to these populations.

From these studies it appears that any threat to the celery crop by *Tortrix ivana* Fernald in the Everglades is most likely to come late in the season. The population drops so rapidly in late summer that early plant beds are not likely to be attacked seriously. From the past history of the species it can be concluded quite safely that sporadic damage by this insect may occur during the winter months, when as yet unrecognized ecological conditions are favorable. Population trends during this study were quite similar for each year, the peak population ranging from the last half of May to late in June. Late summer, fall and midwinter populations have been uniformly low.

Tortrix ivana Fernald is a potentially dangerous insect, capable of causing large economic losses, even though ecological factors may tend to keep the species from becoming a year-to-year pest during the main vegetable growing season. Probably some unrecorded infestations have occurred and some losses have been attributed to other species which occurred simultaneously.

Control

Populations of *Tortrix ivana* Fernald have been too light or sporadic on celery in the Everglades during the course of this study to obtain experimental control data. Hayslip (1948) obtained satisfactory control with a power duster using 5 percent DDT. The duster outlets were permitted to drag through the celery tops during the operation. His observations indicated that a power sprayer apparently did not force the material down into the heart and lower petiole area where the worms were feeding. Recent observations have indicated that a nozzle placement may be used, where one or two nozzles are located over the center of the row to force the foliage open, allowing for spray from two other nozzles to be delivered into the opened tops. This arrangement should give somewhat better coverage than the usual top and side delivery.

Counts made in a commercial field with a heavy adult population in early April indicated that parathion killed many adult moths. Fifty-foot sections of 10 untreated rows and 10 treated rows were beaten in order to flush the moths, which were recorded as they flew from the foliage. Only 32 moths were flushed from the treated rows while 96 were recorded from the untreated rows. A dust of 5 percent DDT and 1 percent parathion is suggested for control of this species. Where growers are not equipped for dusting, a combination of 1 quart of 25 percent DDT emulsion and 1 pint of 25 percent parathion emulsion per hundred gallons of water is suggested, applying 200 gallons per acre with the above mentioned nozzle placement.

Summary

Tortrix ivana Fernald has been a sporadic pest of celery in the Everglades since 1933. The insect may cause great injury because the larvae feed extensively in the bud and petiole area, where contact with insecticides is difficult to obtain. Field observations and a study of population trends of adult moths indicate that this species is most likely to be a sporadic or late season pest of celery. Best control has been obtained with DDT dust applied with power dusters with outlets dragging through the celery tops. Parathion sprays appeared to reduce the population of ovipositing adults. A combination dust, containing 5 percent DDT and 1 percent parathion, would probably be superior to DDT alone against this species. The moth has a wide range of host plants, including a number of common weeds. The population peak normally appears not to be reached until the celery season is nearly over. The duration of the stages under spring conditions was found to be as follows: egg, 5-12 days; larva, 16-20 days; pupa, 7 days. A bethylid parasite attacks the larvae and *Trichogramma* sp. attacks the eggs.

Acknowledgments

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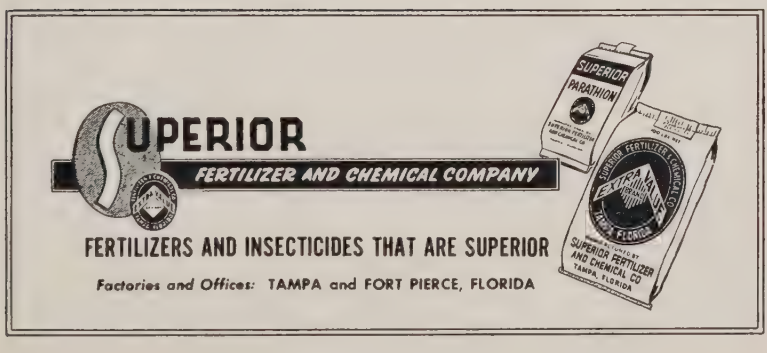

A NEW NORTH AMERICAN *MOZENA* (HEMIPTERA: COREIDAE)

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Several years ago, during a study of certain Coreidae in the University of Michigan Museum of Zoology, it became evident to me that the original description by Stål (1862) of *Mozena nestor* and the colored figure of Stål's type given by Distant (1881) could not be reconciled with Texas specimens labeled *nestor* by J. R. de la Torre-Bueno in 1920 or 1921 and running to that species in his "Synopsis" (1941). These specimens seemed, instead, to represent an undescribed species. Correspondence with Dr. R. I. Sailer revealed that both he and Mr. H. G. Barber had independently recognized this new species in the U. S. National Museum collections. Dr. Sailer has most generously forwarded the specimens from that Museum to me for study, and they are included among the paratypes listed below.

Mozena buenoi, new species

Mozena nestor [nec] Stål, Torre-Bueno, 1941, Ent. Amer. 21(2): 55.

More robust than *M. lunata* (Burm.) or *M. arizonensis* Ruckes; shape of pronotum like that of *M. nestor* as figured by Distant; smaller than *nestor* (whose female type measured 26 mm.), with wider abdomen which is virtually as wide as pronotum, and with femoral tubercles white, not black.

Length (♂ holotype) 18.5 mm. Width 8.3 mm. across humeral angles, 6.5 mm. across base of hemelytra, 8.2 mm. across apex of fifth abdominal segment. Color commonly cinnamomeous; basal part of pronotum at middle, broad lateral margins of scutellum, and basal third or more of exposed connexival segments yellowish; corium more or less widely suffused with yellowish along apical margin. Thoracic pleura with a longitudinal, yellowish or ivory-white, callous ridge, more or less interrupted, above coxal cavities, turning obliquely upward and backward at middle of metapleura; coxal cavities, posterodorsal corner of metapleura, and lower half of hind margin of propleura more or less ivory white, punctate with reddish brown. Abdominal segments 3 to 6 each side (sometimes segment 7 also) with a conspicuous, yellow or ivory-white, callosity, those of segments 3 and 4 almost longitudinal, but slightly dislocated at the intersegmental suture, that of segment 5 a little more oblique, those of segments 6 and 7 (when present) much more oblique and entirely disconnected from the ones on preceding segments, callosities of segments 3 to 5 (sometimes also that on 6) abruptly widened behind middle of segment.

Antennae reddish cinnamomeous, basal segment much darker to almost black above, fourth segment usually quite heavily infuscated; lengths of segments 1 to 4 (in hundredths of a millimeter), 270:280:245:280. Pronotum thickly rugulose-punctate, more strongly transversely rugulose on area before scutellum; lateral margins before the sinus with 10 to 12 small, white tubercles, anterolateral and posterolateral margins of humeral processes narrowly white, crenulate; humeral angles flaring, their anterior margins very lightly *convex*, tipped with a small, subacute tooth directed out-

ward or slightly backward but never upward. Scutellum transversely rugose, and sparsely, coarsely punctate. Segment 4 of connexivum denticulate, segments 5 and 6 distinctly toothed at outer apical angle.

Hind femora about ⅜ as thick as long, thickest somewhat beyond middle; dorsal surface with two rows of small, widely spaced, white tubercles, and with a lateral row of similar tubercles on anterior face; posteroventrally with a stout tooth at the thickest point, followed by two smaller ones, and anteroventrally with two or three smaller, black-tipped teeth on apical third. Hind tibia strongly compressed, distinctly curved upward on apical half; ventral edge with a stout tooth somewhat beyond middle and with two or three smaller teeth and numerous denticles distad of this.

Female very like the male in size, form, and color. Hind femora less swollen and with smaller teeth, the white tubercles less conspicuous; hind tibiae narrower, less strongly curved, and with smaller teeth; anterior half of dorsal margin often black in color.

Holotype male and allotype female, Juniper Canyon, Chisos Mountains, Texas, July 5, 1928 (F. M. Gaige), in University of Michigan Museum of Zoology. Paratypes, 35 males and females, as follows. TEXAS: topotypic, July 8, 1928 (F. M. Gaige); Chisos Mountains, Sept. 1 (G. M. Greene), June 10-12, 1908 (Mitchell and Cushman), July 19 (J. W. Green); Chisos Mountains, Big Bend Park, July 2-5, 1942 (H. A. Scullen); Alpine, June 4-5, 1927; Davis Mountains, June 26, 1942 (H. A. Scullen); Fort Davis, summer 1914 (C. Thompson), labeled *Mozena nestor* Stål by J. R. de la Torre-Bueno. ARIZONA: Dewey, Aug. 1917; Huachuca Mountains, June 9, 1935 (J. N. Knull); Chiricahua Mountains, July 22, 1945 (W. W. Jones). MEXICO: 6 mi. n. Jalostitlan, Jalisco, Aug. 20, 1954 (R. R. Dreisbach). Paratypes in University of Michigan Museum of Zoology, U. S. National Museum, University of Florida Collections, and collection of R. R. Dreisbach. A few paratypes are labelled simply "Tex." or "Ari." and bear neither definite locality, date, or collector's name.

There is considerable variation in color within the species, the palest individuals presenting rather a grayish tinge above, not unlike that frequently seen in *M. arizonensis*. Some specimens are quite definitely yellow beneath, but even on these the pale callosities of pleura and abdomen stand out strikingly distinct. Total length varies in the specimens seen from 18.1 mm. to 23.5 mm., but most specimens are less than 20 mm. long.

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